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ORIGINAL RESEARCH

Impact of COVID-19 State of Emergency restrictions on presentations to two Victorian emergency departments

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Abstract

Objective: To determine if COVID-19 State of Emergency (SOE) restrictions were associated with a reduction in presentations to two urban EDs in Melbourne, Victoria.

Methods: This retrospective observational study included adult patients presenting to The Alfred and Sandringham Hospital EDs during the first month of stage 2 and 3 SOE restrictions (26 March–25 April 2020). Patients transferred from other hospitals or diagnosed with COVID-19 were excluded. The primary outcome was the average number of presentations per day. Secondary outcomes included the average daily number of presentations for pre-specified subgroups defined by triage category and diagnosis. The independent impact of SOE restrictions, adjusted for underlying trends in attendance, was determined using negative binomial regression and reported as an incident rate ratio (IRR) with a 95% confidence interval (CI).

Results: Average daily attendance during the exposure period was 174.7. In the absence of SOE restrictions, 278.8 presentations per day were predicted, a reduction of 37.3% (IRR 0.63, 95% CI 0.59–0.67). Attendance was lower than anticipated for all triage categories (especially category 5 [IRR 0.51, 95% CI 0.44–0.59]) and diagnostic groups (including circulatory problems [IRR 0.62, 95% CI 0.50–0.76] and injury [IRR 0.58, 95% CI 0.53–0.63]). There were fewer than predicted presentations for several sentinel diagnoses, including gastroenteritis (IRR 0.27, 95% CI 0.17–0.42) and renal colic (IRR 0.55, 95% CI 0.33–0.92).

Conclusions: SOE restrictions were associated with a significant reduction in ED presentations across a range of triage categories and diagnoses. Public health messaging should emphasise the importance of timely ED attendance for acute illness and injury.

Key words: *COVID-19, emergency care, pandemic, public health.*

Key findings

- The Victorian Government has implemented physical distancing measures in order to control community transmission of the SARS-CoV-2 virus.
- In the first month of stage 2 and 3 State of Emergency restrictions, ED attendance for non-COVID conditions was substantially lower than predicted. This association was evident across a range of triage categories and diagnostic groups, but was more pronounced among lower acuity presentations.
- Further research is warranted to explore the reasons behind the change in ED attendance patterns.

Introduction

COVID-19, caused by the SARS-CoV-2 virus, has had devastating health, social and economic effects across the world. The outbreak was declared a pandemic on 11 March 2020, and has been implicated in at least 600 000 deaths to date.[1,2]

In order to supress community transmission of the virus, a large number of countries have implemented physical distancing interventions.[3–5] Measures such as workplace avoidance, school closure, case isolation and community contact reduction have been successful at flattening the epidemic curve and dispersing the impact on health services.[5–7]

In the setting of rising COVID-19 case numbers, the Victorian Government declared a State of Emergency (SOE) and implemented stage 1 physical distancing

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restrictions on 16 March 2020. These were escalated to stage 2 restrictions from 26 March and stage 3 restrictions from 31 March. Stage 3 SOE measures permit individuals to leave their place of residence for only four reasons: to shop for essential supplies, to exercise, to work or study (if this cannot be done remotely) and to seek medical care.[8]

There are anecdotal reports that SOE measures have resulted in decreased ED attendance.[9] Some of this effect is likely to be explained by reduced risk exposure and the restriction of certain activities, especially those associated with injury. Another possible explanation is that a proportion of patients with time-sensitive, non-COVID conditions are deferring ED presentation, seeking care elsewhere or avoiding medical attention. Fear, as has been observed in other countries[10,11] and during previous epidemics,[12] may be contributing to changing patterns of healthcare seeking behaviour.

The aim of the present study was to determine if the Victorian Government's COVID-19 SOE measures were associated with a reduction in ED attendance. This knowledge is essential to understanding the impact of the pandemic, and the associated physical distancing interventions, on non-COVID conditions.

Methods

A retrospective observational study was performed across two EDs in Melbourne, Victoria. The Alfred Hospital (AH) is a tertiary, adult, inner urban, level 1 trauma centre with statewide speciality services and an annual ED census of approximately 70 000. Sandringham Hospital (SH) is a mixed paediatric and adult ED in a suburban setting. It has an annual census of approximately 45 000 and capacity to admit adult patients for medical, surgical and obstetric care. During the first month of SOE measures, the number of patients diagnosed with COVID-19 at both sites was low.[13]

Adult patients presenting to AH or SH ED during the study period were included. Patients were excluded if they were transferred from another hospital or had a positive SARS-CoV-2 swab result during their ED encounter.

A COVID-19 screening clinic, servicing both sites from a location within AH, was operational during the study period but did not fall under the governance of the ED. The clinic facilitated SARS-CoV-2 testing but not medical assessment. Patients who attended only the screening clinic, and did not present to the ED, were excluded.

The study period was the first month of the Victorian Government's stage 2 and 3 SOE measures (26 March–25 April 2020). The primary outcome was the average daily number of ED presentations, and the primary exposure was the presence of SOE restrictions. Negative binomial regression modelling, incorporating ED presentation data for the same 31-day period in 2017, 2018 and 2019, was used to adjust for underlying attendance trends. The measure of association for the independent impact of the primary exposure (SOE) on the primary outcome (daily number of ED presentations) was the incident rate ratio (IRR) with a 95% confidence interval (CI).

Secondary outcomes included the average daily number of ED presentations in pre-specified subgroups defined by site, arrival mode, triage score and diagnostic category (of the primary ED diagnosis). A sample of 10 diagnostic categories, grouped by ICD-10 chapter, were pre-selected for analysis: infectious diseases (chapter 1), endocrine (chapter 4), mental health (chapter 5), circulatory (chapter 9), respiratory (chapter 10), digestive (chapter 11), skin (chapter 12), genitourinary (chapter 14) and injury and poisoning (chapter 19).

The average daily number of presentations, and the effect of SOE restrictions, was also determined for 10 sentinel ED diagnoses (defined by the ICD-10 code assigned at the point of ED departure): AMI (I213-I214), anaphylaxis (T805, T886), gastroenteritis (A090), appendicitis (K358), renal colic (N23), migraine (G439), fractured hip (S7208), fractured wrist (S628), dislocated shoulder (S4300) and burns (T20-32). These conditions were chosen as examples of diagnoses that are common, require timely intervention and can be identified with relative accuracy in the ED setting. Diagnoses such as pneumonia and sepsis were avoided to mitigate the risk of confounding from COVID-19, and presenting complaint categories could not be used because of a lack of categorical coding and potential for misclassification bias. In addition, the impact of SOE restrictions was determined for several patient outcomes, including disposition, mortality and hospital length of stay.

Data were extracted from the AH and SH electronic medical record system through a specific query of the Alfred Health data warehouse. This was performed 1 month after

TABLE 1. *Patient demographics*

	2017, *n* (%)	2018, *n* (%)	2019, *n* (%)	2020, *n* (%)
Average daily attendance	255.3 (100%)	257.4 (100%)	272.2 (100%)	174.7 (100%)
Presented to Alfred Hospital ED	164.3 (64.4%)	169.2 (65.7%)	178.4 (65.5%)	110.0 (63%)
Female sex	125.0 (49%)	122.4 (47.5%)	131.0 (48.2%)	84.2 (48.2%)
Age ≥70 years	62.0 (24.3%)	58.1 (22.6%)	61.3 (22.5%)	37.8 (21.6%)

TABLE 2. *Predicted* versus *observed daily attendance during the exposure period*

	Predicted attendance		Observed attendance		Effect of year			Effect of SOE restrictions		
Category	*n*	%†	*n*	%†	IRR	95% CI (lower)	95% CI (upper)	IRR	95% CI (lower)	95% CI (upper)
Average daily attendance	278.8	100.0%	174.7	100.0%	1.03	1.01	1.06	0.63	0.59	0.67
Site										
The Alfred	185.2	66.4%	110.0	63.0%	1.04	1.02	1.06	0.59	0.56	0.63
Sandringham	93.8	33.6%	64.7	37.0%	1.02	0.99	1.04	0.69	0.64	0.74
Arrival mode										
Ambulance	71.2	25.5%	53.1	30.4%	1.08	1.04	1.11	0.75	0.69	0.81
Triage category										
1	1.9	0.7%	1.4	0.8%	1.05	0.89	1.25	0.74	0.42	1.32
2	32.7	11.7%	22.7	13.0%	1.05	1.00	1.10	0.69	0.61	0.78
3	108.0	38.7%	72.4	41.4%	1.07	1.04	1.10	0.67	0.63	0.72
4	114.6	41.1%	66.8	38.3%	1.01	0.99	1.03	0.58	0.55	0.62
5	22.3	8.0%	11.3	6.5%	0.97	0.92	1.02	0.51	0.44	0.59
Diagnostic group										
Infectious diseases	8.7	3.1%	6.2	3.5%	1.07	0.97	1.17	0.71	0.56	0.90
Endocrine	2.5	0.9%	1.0	0.6%	1.16	0.96	1.39	0.41	0.25	0.68
Mental health	9.2	3.3%	6.5	3.7%	1.00	0.92	1.08	0.70	0.56	0.88
Nervous system	6.1	2.2%	3.4	1.9%	1.05	0.94	1.16	0.55	0.41	0.74
Circulatory	11.4	4.1%	7.0	4.0%	0.99	0.92	1.06	0.62	0.50	0.76
Respiratory	9.8	3.5%	7.7	4.4%	0.96	0.89	1.04	0.78	0.63	0.96
Digestive	10.8	3.9%	6.9	4.0%	0.95	0.88	1.02	0.64	0.52	0.79
Skin	10.5	3.8%	6.0	3.4%	0.99	0.92	1.07	0.57	0.46	0.71
Genitourinary	8.8	3.2%	5.4	3.1%	0.94	0.87	1.02	0.61	0.49	0.77
Injury and poisoning	65.1	23.3%	37.8	21.6%	0.97	0.94	1.00	0.58	0.53	0.63
Sentinel diagnoses										
Appendicitis	0.6	0.2%	0.6	0.3%	0.78	0.61	1.02	0.89	0.42	1.91
Anaphylaxis	0.7	0.2%	0.5	0.3%	0.86	0.66	1.11	0.75	0.35	1.60
Gastroenteritis	4.1	1.5%	1.1	0.6%	0.97	0.85	1.10	0.27	0.17	0.42
Fractured hip	0.4	0.2%	0.7	0.4%	0.69	0.52	0.90	1.73	0.81	3.72
Fractured wrist	2.8	1.0%	1.2	0.7%	0.92	0.80	1.05	0.41	0.26	0.65
Renal colic	2.0	0.7%	1.1	0.6%	0.98	0.82	1.17	0.55	0.33	0.92

(*Continues*)

TABLE 2. *Continued*

Category	Predicted attendance		Observed attendance		Effect of year			Effect of SOE restrictions		
	n	%†	*n*	%†	IRR	95% CI (lower)	95% CI (upper)	IRR	95% CI (lower)	95% CI (upper)
Burns	1.5	0.5%	1.6	0.9%	1.09	0.87	1.37	1.08	0.62	1.87
Shoulder dislocation	0.6	0.2%	0.5	0.3%	0.83	0.63	1.08	0.71	0.32	1.58
Migraine	1.8	0.6%	0.7	0.4%	1.10	0.89	1.37	0.42	0.23	0.77
AMI	0.6	0.2%	0.7	0.4%	0.88	0.68	1.13	1.01	0.49	2.07

†All percentages use total attendance (predicted or observed) as the denominator. CI, confidence interval; IRR, incident rate ratio; SOE, State of Emergency.

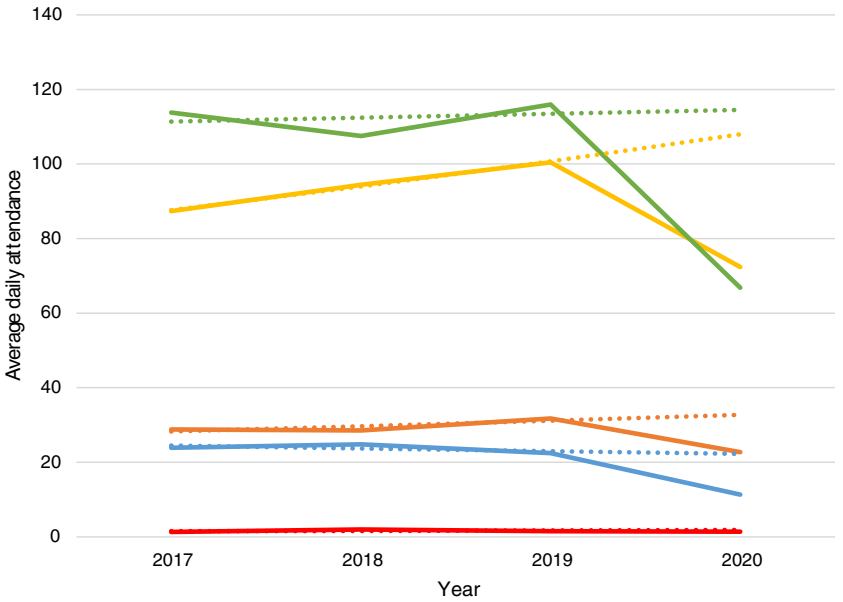

Figure 1. *Predicted* versus *observed attendance by triage category. (——) Cat 1 observed; (——) Cat 2 observed; (——) Cat 3 observed; (——) Cat 4 observed; (——) Cat 5 observed; (·····) Cat 1 predicted; (·····) Cat 2 predicted; (·····) Cat 3 predicted; (·····) Cat 4 predicted; (·····) Cat 5 predicted.*

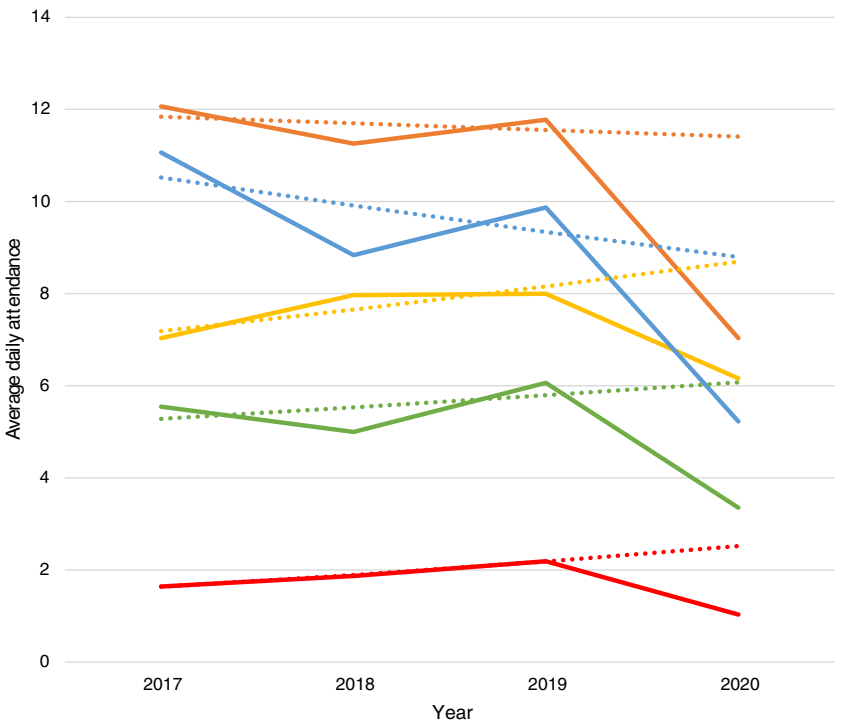

Figure 2. *Predicted* versus *observed attendance by diagnostic group (selected). (——) Endocrine observed; (——) Circulatory observed; (——) Infectious diseases observed; (——) Nervous system observed; (——) Genitourinary observed; (·····) Endocrine predicted; (·····) Circulatory predicted; (·····) Infectious diseases predicted; (·····) Nervous system predicted; (·····) Genitourinary predicted.*

the conclusion of the study period to allow sufficient time for admitted patient outcomes (e.g. discharge or death) to occur. Statistical analysis was undertaken in STATA version 16.1 (College Station, TX, USA). Ethics approval was granted by the AH Ethics Committee (reference 265/20, 5 May 2020).

Results

There were 5414 eligible ED presentations during the SOE exposure period (26 March–25 April 2020), an average of 174.7 per day. This compared with 255.3 in 2017, 257.4 in 2018 and 272.2 in 2019. Patient demographics are described in Table 1.

The IRR for the effect of year was 1.03 (95% CI 1.01–1.06), resulting in a predicted average daily attendance of 278.8 in 2020. Observed daily attendance was 174.7, a reduction of 37.3% (IRR 0.63 [0.59–0.67]).

Differences in predicted *versus* observed daily attendance across the various secondary outcome measures are displayed in Table 2. Presentations were lower than anticipated across triage categories 2–5, with a more pronounced reduction among lower acuity patients (Fig. 1). There was no difference in attendance for category 1 patients (IRR 0.74, 95% CI 0.42–1.32).

Lower than predicted attendance was also observed across the 10, preselected diagnostic categories, especially endocrine conditions (IRR 0.41, 95% CI 0.25–0.68), nervous system pathology (IRR 0.55, 95% CI 0.41–0.74), skin problems (0.57, 95% CI 0.46–0.71) and injury and poisoning (IRR 0.58, 95% CI 0.53–0.63). Reductions were also seen in mental health presentations (IRR 0.70, 95% CI 0.56–0.88). Data for an indicative range of diagnostic groups is displayed in Figure 2.

Attendance was lower than expected for several sentinel diagnoses, including gastroenteritis, renal colic, migraine and wrist fracture. Presentations with AMI (IRR 1.01, 95% CI 0.49–2.07) and burns (IRR 1.08, 95% CI 0.62–1.87) were unchanged.

Differences in ED outcomes are displayed in Table 3. Reductions were seen in the number of hospital admissions and the number of patients with an ED length of stay greater than 4 h.

Discussion

This study has demonstrated that Victoria's stage 2 and 3 COVID-19 SOE restrictions were associated with a significant reduction in ED attendance. The effect was evident across all triage groups and diagnostic categories, with the exception of

TABLE 3. *Predicted* versus *observed patient outcomes during the exposure period*

	Predicted attendance		Observed attendance		Effect of year			Effect of SOE restrictions		
Category	*n*	%†	*n*	%†	IRR	95% CI (lower)	95% CI (upper)	IRR	95% CI (lower)	95% CI (upper)
Disposition										
Admitted to ESSU	82.0	29.4%	52.7	30.2%	1.02	0.98	1.05	0.64	0.59	0.70
Admitted to hospital	47.4	17.0%	35.3	20.2%	1.00	0.95	1.05	0.74	0.66	0.84
Admitted to ICU	1.8	0.6%	1.8	1.0%	1.02	0.84	1.23	1.02	0.63	1.65
Transferred to other hospital	1.7	0.6%	1.7	1.0%	0.78	0.66	0.91	1.01	0.64	1.61
Mortality										
Died in ED	0.1	0.0%	0.1	0.0%	0.66	0.35	1.26	0.96	0.12	7.69
Died in hospital‡	1.6	0.6%	0.9	0.5%						
Length of stay										
ED LOS >4 h	51.1	18.3%	23.4	13.4%	1.18	1.08	1.30	0.46	0.36	0.58
Hospital LOS >72 h‡	29.0	10.6%	22.0	12.6%						

†Unless otherwise stated, all percentages use total attendance (predicted or observed) as the denominator. ‡Data for 2017 and 2018 were not available to the researchers through the Alfred Health data warehouse. Figures in predicted column represent observed frequency and proportion in 2019. CI, confidence interval; ESSU, emergency short stay unit; IRR, incident rate ratio; LOS, length of stay; SOE, State of Emergency.

the most urgent patients (triage category 1). The association was also observed for several sentinel diagnoses, including conditions requiring timely medical interventions (such as analgesia).

Not unexpectedly, the reduction in attendance was especially marked among category 4 and 5 patients. By definition, these groups have semi-urgent and non-urgent health needs, so it is conceivable that patients with non-emergent conditions may have deferred ED attendance or sought healthcare elsewhere. Consistent with the observation, higher acuity diagnoses (such as appendicitis, AMI and burns) did not appear to decrease.

A reduced burden of trauma is in keeping with the 'stay at home' directive, and likely reflects marked decreases in traffic volume, recreational activity and organised sport. The closure of pubs and clubs may also have had the effect of reducing presentations linked to alcohol-related violence and injury, but this was not specifically explored in this study.

Presentation frequencies for renal colic and migraine, both painful, atraumatic diagnoses, were lower than expected by a substantial margin. One hypothesis is that patients elected not to seek emergency healthcare for acute pain. An alternative explanation is that an indirect effect of the SOE was to reduce the incidence of these conditions, negating the need for ED attendance.

These data are broadly consistent with observations from other developed countries.[10,11,14–16] In the UK, for example, ED attendance dropped between 25% and 49% following the implementation of lockdown measures.[14] Reductions were seen across all diagnostic groups with the exception of pneumonia, which likely reflects the high incidence of COVID-19 in the UK population. Similar observations have been made in Germany and the USA.[10,15]

Reductions in specific, time-sensitive, non-COVID conditions have also been described. For instance, in the period prior to the pandemic, the city of Piacenza in Italy recorded a monthly average of 51 stroke cases. During the first month of the pandemic, only six patients were diagnosed with acute ischaemic stroke.[17] In the USA, a 38% decrease in the number of cardiac catheter laboratory activations for ST-elevation MI has been reported.[18] These observations have triggered calls for patients with acute illness and injury to attend EDs if and when required.[15]

The findings of the present study have important implications, particularly at a time when Victoria is experiencing a 'second wave' of COVID-19 infections. They raise the possibility that some patients with time-sensitive health conditions are avoiding medical assessment in the ED. Although a reduction in certain presentations can be explained by activity and movement restrictions associated with the SOE (e.g. trauma), the introduction of physical distancing measures does not plausibly explain the decreased frequency of all acute conditions. It also raises concerns that some patients with chronic illness (e.g. diabetes or heart failure) may be forgoing ED attendance when they experience an exacerbation of their underlying disease.

Although these data are instructive, they do not explain the reasons for underattendance. Contributing factors may include reluctance to visit health services managing COVID-19 patients, and misinterpretation of public health messaging to 'stay at home'. Fear is likely to explain some of the effect, given that it has been observed in other settings[10,11] and was thought to be a driver of reduced ED attendance during the 2003 severe acute respiratory syndrome epidemic.[12,19] Positive health impacts from the unprecedented SOE in Victoria cannot be excluded, however, and qualitative research is required to better understand the factors that may have led to changes in healthcare seeking behaviour.

The major limitation of the present study is its retrospective design. Additionally, the study was limited to two urban EDs, and the findings may not be generalisable to other Victorian hospitals, nor other jurisdictions that have implemented physical distancing restrictions. The study also excluded children, so no conclusions can be made about paediatric patients. Multi-site research, using time-series analysis, would shed further light on the longitudinal impact of COVID-19 on ED attendance. Studies of this nature are currently being developed.

Overall, this research adds to the emerging body of evidence regarding the indirect effects of the pandemic and the associated public health control measures.[20–22] Physical distancing interventions are associated with a large number of adverse health effects, and the present study raises the possibility that patients with acute, non-COVID conditions are among those impacted.[20] The pandemic may also have influenced the incidence and severity of disease exacerbations among patients with chronic conditions, a group at risk of poor health outcomes during the pandemic.[23]

In the setting of a 'second wave' of COVID-19 and ongoing physical distancing restrictions in Victoria, it is critically important that governments remind patients and the public to seek early medical assessment for acute illness and injury. EDs play an important role in minimising morbidity and mortality associated with time-sensitive conditions, but the ability to influence patient outcomes is limited in the setting of delayed presentations and non-attendance.

Conclusions

Victoria's stage 2 and 3 COVID-19 SOE restrictions were independently associated with a significant reduction in ED attendance. The effect was evident across a majority of triage categories and a range of diagnoses. Although the reasons for this change remain unknown, it is critical that public health messaging emphasises the importance of timely ED attendance for acute illness and injury.

Author contributions

All authors provided input into study design. RDM was primarily responsible for data analysis and wrote the first draft. GMOR provided statistical advice. All authors reviewed the manuscript.

Competing interests

GMOR, BM and PAC are section editors for *Emergency Medicine Australasia*.

Data availability statement

The data supporting these findings are available from the authors on reasonable request, subject to the conditions of the study's ethics clearance.

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